

# NASA's Return On Investment Report

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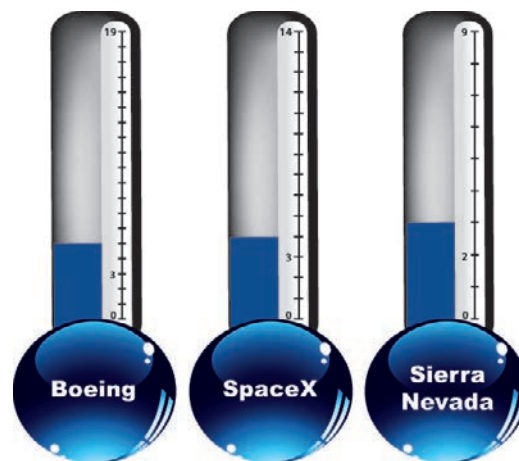
*This bi-monthly newsletter of accomplishments, progress, and happenings in NASA's commercial crew and cargo development programs is distributed by the Commercial Spaceflight Development Division at NASA Headquarters.*

## Commercial Crew Partners Achieve More Milestones

Commercial Crew Integrated Capability (CCiCap) milestones are on schedule, putting the U.S. one step closer to ending the gap in human access to space. In less than six months, twelve of the forty two planned milestones have been successfully completed. Furthermore, each of the partners has achieved progress beyond the formal milestone work content.

Sierra Nevada Corporation (SNC) completed its first Integrated System Safety Analysis Review in January, which analyzed potential safety hazards and controls for the Dream Chaser spacecraft, Atlas V launch vehicle, and ground and mission systems. Meanwhile, assembly, integration, and testing of the Dream Chaser test vehicle continued at SNC's Louisville, Colo. facility. When completed, the vehicle will be shipped to NASA's Dryden Flight Research Center at Edwards Air Force Base, Calif. There, it will be used for unpowered free flight approach and landing tests in the coming months. In addition to its formal milestone work, SNC has begun taking steps to manufacture their next test vehicle structure at NASA's Michoud Assembly Facility in New Orleans.

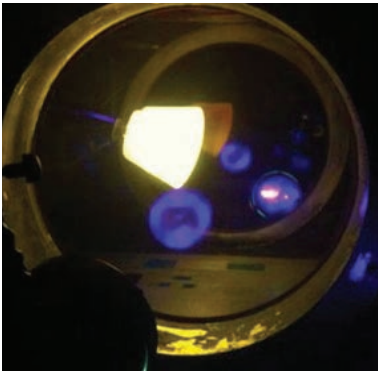
In December, Space Exploration Technologies (SpaceX) conducted its Ground and Ascent Preliminary Design Review milestone. The review covered their latest designs as well as the Falcon 9 and Dragon spacecraft performance during the ascent and abort flight regimes. In addition, SpaceX continued qualification testing of the Falcon 9 "version 1.1" launch vehicle in preparation for upcoming commercial and NASA missions. In partnership with NASA's Langley Research Center in Hampton Roads, Va., SpaceX recently performed aerothermal wind tunnel testing of a Dragon spacecraft scale model. Development and testing of the SuperDraco launch abort system engine continues, with 58 test firings for 112 seconds total accumulated run time to date.



CCiCap milestone completion status—Boeing: 5 of 19. SpaceX: 4 of 14. Sierra Nevada: 3 of 9.



Fin bending load test on the Dream Chaser test vehicle. Photo courtesy of Sierra Nevada



Dragon spacecraft aerothermal wind tunnel testing at NASA's Langley Research Center.  
*Photo courtesy of SpaceX*

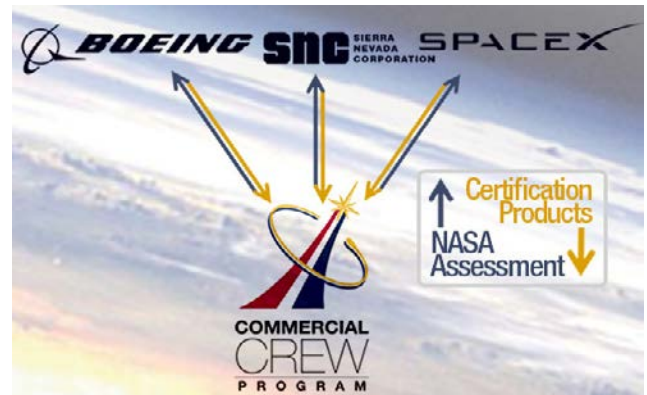
The Boeing Company recently completed two CCIcap milestones—an engineering release of flight software for testing, and a Landing and Recovery and Ground Communications Design Review. This recent review completed the preliminary design phase of the full ground systems element for Boeing's integrated crew transportation system. In addition to CCIcap milestones, Boeing is continuing work at NASA's Kennedy Space Center in Florida to convert former space shuttle facilities for CST-100 processing and operations use, and the company recently completed development tests of up-righting bags for contingency water landings.



Boeing CST-100 development test of up-righting system. *Photo courtesy of Boeing*

## NASA PLANS QUICK RESPONSES TO COMMERCIAL CREW PHASE I CERTIFICATION DELIVERABLES

In December, NASA selected Boeing, Sierra Nevada, and SpaceX for Commercial Crew Program phase I certification contracts. Under these, also known as "Certification Products Contracts" (CPCs), the Commercial Crew partners will provide NASA with their proposed alternate standards, preliminary hazard analyses work, and plans for verification, validation, and certification. NASA experts then will assess these deliverables, relative to proven agency requirements and standards for human spaceflight, and provide feedback to the partners regarding the acceptability of their approaches toward ultimately achieving NASA certification to transport astronauts to and from the International Space Station. NASA's responses will represent binding decisions that will carry forward into the next phase of certification, and therefore must be carefully analyzed and considered. Kickoff meetings have now been held with all three contractors and the work on NASA certification for ISS crew rotation services is underway.



Through CPC, NASA receives and assesses commercial partners' plans to meet NASA requirements.

To maintain the partners' fast-paced momentum to develop crew transportation systems that will once again enable sending people to space from U.S. soil, NASA has committed to providing responses to every CPC deliverable within 90 days of receipt. NASA anticipates dozens of products will be delivered from each partner. Some will involve complex topics, including innovative ways of ensuring safety through design and testing that differ from NASA's traditional experiences.

Given this large volume of expected work, its technical complexity, and the lean size of the NASA workforce supporting Commercial Crew, producing timely responses will be a tremendous challenge for the Commercial Crew Program. According to Phil McAlister, NASA's director of Commercial Space Development, "This is our first opportunity to begin telling our partners how well their plans meet our requirements for the NASA missions. It is critical that we provide timely feedback in order to influence their designs without slowing their progress."

To meet the challenge, the Commercial Crew Program has initiated an organizational structure to give special attention to CPC product evaluation. With the start of CPCs, a deputy specifically responsible for products required for NASA certification has been added to the leadership of each partner integration team. Furthermore, the Commercial Crew Program has established a product flow management group which is responsible for coordinating the workload across all the partner teams, and in particular expediting the internal NASA reviews culminating with the formal Program-level decision boards.

NASA is open to alternative approaches to its requirements, and believes that there is more than one way to

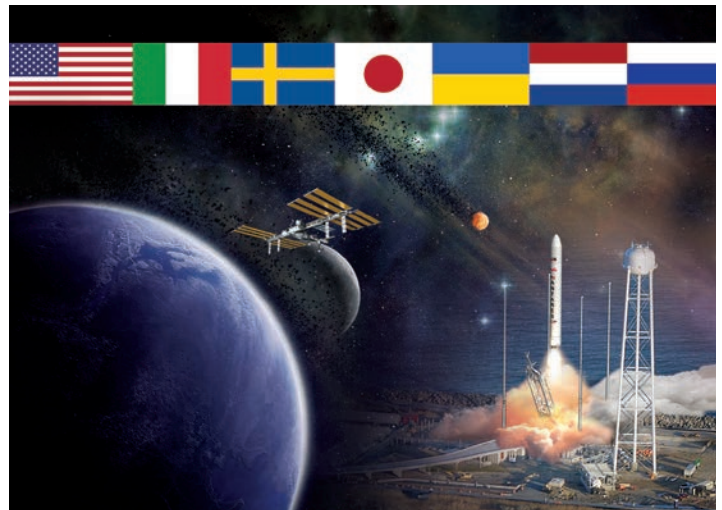


fly safely. CPC is the mechanism that now allows NASA to formally tell its partners which innovative methods will be acceptable when it comes time to fly NASA astronauts to the Space Station on the commercial systems. Developing clear and timely decisions for the commercial partners is being given the highest priority in the months to come.

## ORBITAL SCIENCE'S MULTI-NATIONAL EFFORT

Orbital Sciences Corporation (Orbital) of Dulles, Va., has engaged top aerospace organizations in the United States and from across the globe to help develop the Antares launch vehicle and Cygnus cargo spacecraft for upcoming space station cargo resupply missions. This approach supports timely and cost effective development of their new commercial cargo transportation system and is consistent with the National Space Policy of the United States which has a goal to "expand international cooperation on mutually beneficial space activities".

Orbital is the Antares prime integrator and has overall responsibility for systems engineering and integration, avionics development, software, guidance/navigation and control, primary structure, testing, verification and operations.



*Artist conception courtesy of NASA*

Orbital is working with KB Yuzhnoye/PO Yuzhmash of Ukraine for design, production and verification of the propellant tanks and associated pressurization system used on the first stage of the launch vehicle. The first stage engines are being provided by Aerojet and are updated NK-33s, originally manufactured by the Kuznetsov Design Bureau for the Soviet Union N-1 rocket program. The second stage incorporates a solid rocket motor provided by Alliant Techsystems Inc. (ATK) of Minneapolis, Minn. The payload separation system is procured from Ruag of Sweden, a world leader in design and production of low-shock separation devices.

The Cygnus spacecraft Service Module is designed and integrated by Orbital. Components for the Cygnus spacecraft are a combination of internally manufactured and subcontracted hardware from various countries. The Pressurized Cargo Module (PCM), for example, was designed and is being manufactured by Thales Alenia Space in Torino Italy, who also developed the International Space Station MPLM (Multi-Purpose Logistics Module). Orbital also contracted with other non-U.S. suppliers including Mitsubishi Electric Corporation (MELCO) of Tokyo Japan for the Proximity Location System and Dutch Space of the Netherlands for its solar arrays.

All elements will come together at the Wallops Flight Facility in Wallops Island, Va. in preparation for upcoming ground tests and flight planned for the next few months.

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To download the latest information on the Commercial Crew Program, visit:  
<http://go.nasa.gov/commercial-documents>

To watch the latest Commercial Crew video "Accelerating an American Ride to Low-Earth Orbit" visit:  
<http://go.nasa.gov/W3xagp>

*For more information on any of the articles in this report, contact Joshua Buck, Rachel Kraft, or Trent Perrotto in NASA's Public Affairs Office at 202-358-1100. To review NASA's other commercial space accomplishments, visit:*  
<http://www.nasa.gov/commercial/>